

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/262735339>

The Length–Weight Relationship and Condition Factor of Nile Tilapia (*Oreochromis niloticus* L.) Broodstock at Kegati Aquaculture Research Station, Kisii, Kenya

Article in *International Journal of Advanced Research* · June 2014

CITATIONS

5

READS

2,934

2 authors:



Elijah Migiro Kembenya

Kenya Marine and Fisheries Research Institute (KMFRI)

12 PUBLICATIONS 38 CITATIONS

SEE PROFILE



Jonathan Munguti

Kenya Marine and Fisheries Research Institute (KMFRI)

56 PUBLICATIONS 417 CITATIONS

SEE PROFILE

Some of the authors of this publication are also working on these related projects:



Nutrition value of Uganda fishes [View project](#)



Integrated Aquaculture [View project](#)



RESEARCH ARTICLE

The Length-Weight Relationship and Condition Factor of Nile Tilapia (*Oreochromis niloticus* L.) Broodstock at Kegati Aquaculture Research Station, Kisii, Kenya

Kembenya E. Migiro^{1*} Erick Ochieng Ogello¹ and Jonathan Mbonge Munguti²

¹Kenya Marine & Fisheries Research Institute (KMFRI), Kegati Aquaculture Research Station, P.O Box 3259-40200 Kisii, Kenya

²Kenya Marine & Fisheries Research Institute (KMFRI), National Aquaculture Research Development & Training Centre (NARDTC), P.O. Box 26, Sagana, Kenya

Manuscript Info

Manuscript History:

Received: 12 March 2014
Final Accepted: 12 April 2014
Published Online: May 2014

Key words:

O. niloticus, Length-Weight relationship, Condition factor, Broodstock, Kegati

*Corresponding Author

Kembenya E. Migiro

Abstract

The present study describes the Length -Weight Relationship (LWR) and condition factor (K) for 215 *Oreochromis niloticus* broodstock from Kegati Aquaculture Research Station, Kenya. The male broodstock (average length 18.3 ± 0.1 cm and weight 126.69 ± 0.2 g) and female broodstock (average length 15.18 ± 0.1 cm and weight 84.84 ± 0.06 g) were randomly sampled from the stations' production ponds and weighed using digital weighing balance (0.1g) and length measured using measuring board (0.1cm). Length-Weight relationship (LWR) was described by the equation: $W = a L^b$ while the condition factor was determined using the equation: $K = 100W / L^b$. The value of the regression co-efficient 'b' obtained for the LWR for the male was 2.5 while that for the female was 3.2 suggesting an isometric growth for the brooders. The mean condition factor for the broodstock was 1.02 ± 0.04 and 1.12 ± 0.02 for males and females respectively. There was a significant difference in condition factor between the male and female brooders (ANOVA, $P < 0.05$). The condition factor was within the standard set for healthy fish and this was indicative that indeed, Kegati broodstock were in good condition for larviculture purposes. Further condition factor analysis should be considered for Nile tilapia fingerlings in the station.

Copy Right, IJAR, 2014,. All rights reserved.

INTRODUCTION

Today, Nile tilapia, which is also popular as 'aquatic chicken' has become the shining star of aquaculture with many farms beginning, others expand as consumption rate increases across the globe (Fitzsimmons, 2005; Ogello et al., 2014). Annual global production of cultured Nile tilapia has continued to increase in recent years in most tropical, subtropical and temperate regions thanks to its favorable culture characteristics (Nandlal and Pickering, 2004; Ashagrie et al., 2008; FAO, 2012). In fact, Nile tilapia is the second most farmed fish in the world after carps (El Sayed, 2002). However, inadequate supply of certified quality feed and seed fish has been a longstanding hurdle to the production of Nile tilapia especially in developing countries (Ogello et al., 2014). Some farmers have given up fish farming because they run into huge losses after stocking their ponds with low-quality fingerlings coming from poorly conditioned broodstocks in many hatcheries (Munguti et al., 2014). Indeed, continued shortage of quality Nile tilapia seed hurts aquaculture activities in tropical countries (El Sayed, 2002). Other challenges in Nile tilapia production include too early maturation and high mortality under crowded conditions (Salama et al., 1996).

Knowledge of quantitative aspects such as length-weight relationship, condition factor, growth, recruitment, and mortality of fishes are important tools for studying fishing biology (Lizama et al., 2002). In fish, the condition factor

(K) reflects, through its variations, information on the physiological state of the fish in relation to its welfare (Ighwela et al., 2011). From a nutritional point of view, there is the accumulation of fat and gonadal development (Le Cren, 1951) while from a reproductive point of view; the highest K values are reached in some species (Ighwela et al., 2011). K also gives information when comparing two populations living in certain feeding, density, climate, and other conditions; when determining the period of gonadal maturation; and when following up the degree of feeding activity of a species to verify whether it is making good use of its feeding source (Weatherley, 1972; Wootton, 1990; Anyanwu et al., 2007). The study of the condition factor is thus important for understanding the life cycle of fish species and contributes to adequate management of these species and, therefore, to the maintenance of equilibrium in the ecosystem (Lizama et al., 2002). Poorly conditioned fishes are associated with negative allometric growth, which implies that the fish becomes more slender as it increases in weight while fishes with appropriate condition factor have isometric growth, which implies that the fish becomes relatively deeper-bodied as it increases in length. The condition factor of fish can be affected by a number of factors such as stress, sex, season, availability of feeds, and other water quality parameters (Khallaf et al., 2003). Most hatchery managers especially in developing countries do not relate the significance of broodstock condition factor to quality fingerling production. Although, the length-weight relationship and feeding habits of tilapia have been studied (Olurin and Aderibigbe, 2006), this information is largely lacking in many hatcheries and production farms dealing with *O. niloticus* in Kenyan. Thus, the present study aims to provide information regarding the length-weight relationship and the condition factor (K) for Nile tilapia broodstock (*O. niloticus*), with a view to determining whether the brooders are in good condition for larviculture production in Kegati Aquaculture Research Station, Kenya.

MATERIALS AND METHODS

Study area

This study was done at Kegati Aquaculture Station in Kisii County, Kenya (00°42"S; 034°47"E). Kisii County lies on a highland equatorial climate; therefore it receives rain almost throughout the year, although there are two rainy seasons (March to May and October to November).

Sample size and data collection

A total of 215 *O. niloticus* broodstock were obtained from production ponds between January and April 2014. The fish were harvested by 50 m long seining net with 0.1cm mesh size and placed in buckets before transporting to the stations' laboratory. The fish were blot-dried to remove the excess water from the body before measuring. This also helped avoid errors during weighing exercise. The male broodstock (average length 18.3 ± 0.1 cm and weight 126.69 ± 0.2 g) and female broodstock (average length 15.18 ± 0.1 cm and weight 84.84 ± 0.06 g) were randomly sampled from the stations' production ponds and weighed using digital weighing balance (0.1g) and length measured using measuring board (0.1cm) as described by Lagler (1970).

Sex determination

Sexing of the fish was manually done. The sex of male fish was determined by the presence of two openings situated just in front of the anal fin, of which one is the anus. The other is the opening of the urethra, at the end of the genital papilla (an oval-shaped lobe just rearward of the anus), from which milt and urine are discharged. The female possess three body openings, of which one is the anus, the urethra and the opening of the oviduct (a crescent-shaped slit), from which eggs are released (Nandlal and Pickering, 2004).

Water quality parameters

Some selected water quality parameters such as pH, DO, temperature, electrical conductivity and total ammonia were measured weekly using surveyor II model hydrolab.

Data analysis

Length-weight relationship

Linear transformation of length and weight of the fish was made using natural logarithm at the observed lengths and weights. The length-weight relationship (LWR) was calculated following Pauly (1983). The LWR was used to calculate the regression coefficient (slope of regression line of weight and length). The parameter "b" of the length-weight relationship were estimated using the formula $W = aL^b$.

Where: W = the weight of the fish in grams,

L = the total length of the fish in centimeters

a = exponent describing the rate of change of weight with length

b = weight at unit length

The expression of the relationship was represented by the following formula:

$$\text{Log } W = b \log L + \log a$$

Condition factor

The value of **b** from the weight-length relation (Lizama et al., 1999) was used to compute the condition factor. Individual values of the condition factor were obtained through the formula $K = 100W/L^b$ (Gomiero and Braga, 2005). The mean condition factor was obtained differently for both males and females.

Where:

K = condition factor

W = the weight of the fish in gram (g)

L = the total length of the fish in centimeters (cm)

b = the value obtained from the length-weight equation.

Results

Water quality analyses

There were no significant differences between water quality parameters within and among the production ponds in the station (ANOVA, $P > 0.05$). Values of the selected water quality parameters are presented in table 1.

Table 1: Water quality parameters recorded during the period of study including \pm Standard Error (SE)

Parameter	Mean (\pm SE)
D.O	8.21 \pm 0.28
PH	6.96 \pm 0.11
Temperature	23.95 \pm 0.22
Conductivity	88.76 \pm 1.55
Total ammonia	1.05 \pm 0.01

Length-Weight relationship

At the end of experiment, the results of the length-weight analysis are presented in Table 2. The mean length for the male broodstock was 18.3 ± 0.1 cm while the mean weight was 126.69 ± 0.2 g. The mean length and weight for the female fish were 15.18 ± 0.1 cm and 84.84 ± 0.06 g respectively. The length-weight relationship among pairs of plotted data, values of determination coefficients and corresponding equation are demonstrated in Figure 2 and Figure 3 for males and females respectively. The values of the regression coefficient obtained from the LWR for males and female brooders and condition factor are presented in table 2. There was significant correlation between

length and weight for both male and female broodstock ($P < 0.05$). There was also a significant difference in condition factor between the males and females of *O. niloticus* ($p < 0.05$).

Table 2: Length-weight relationship, regression coefficient and condition factor parameters of *O. niloticus* in Kegati Aquaculture Station

Sex	N	Mean	Mean	a	b	Condition Factor	
		Length (SE)	Weight (SE)			Range (SE)	Mean(SE)
Male	123	18.3 ±0.1	126.69 ±0.2	-1.09	2.5	0.5 - 1.5	1.02 ±0.04
Female	92	15.18 ±0.1	84.84 ±0.06	-2.17	3.3	0.5 - 3.1	1.12 ±0.02

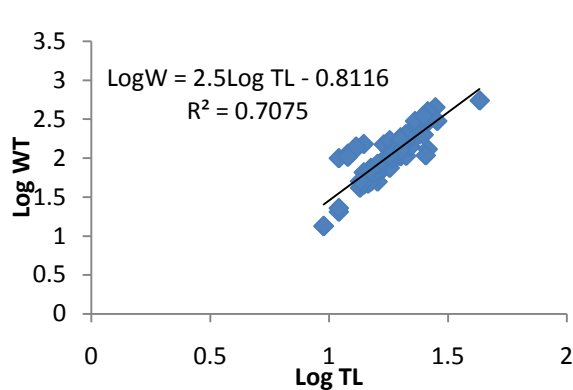


Figure 2: Length-Weight Relationship of *O. niloticus* males

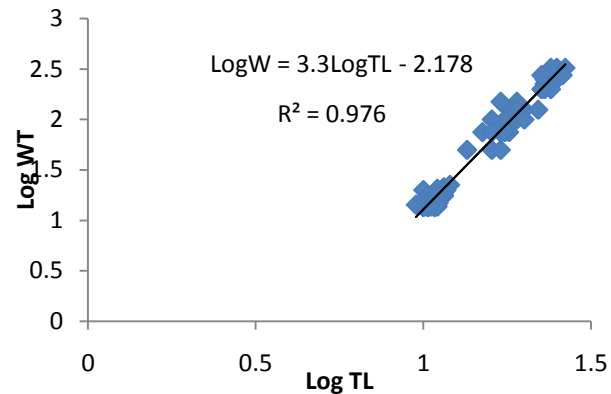


Figure 3: Length-Weight Relationship of *O. niloticus* females

Discussion

The length-weight relationship (LWR) is an important tool that provides information on growth patterns and growth of animals (Ighwela et al., 2011). Fish generally passes through different stages of development which can be defined by different LWR. Statistical analysis of the LWR of the current study showed that the regression coefficients are indicative of isometric growths in males and female brooders. This result was similar to Moradinasab et al. (2012) who concluded that the increase in weight is significant with every unit increase in length for isometric growths. The values of 'b' in this study were 3.3 for the females and 2.5 for the males. These values were within the range of 2 - 4 recommended by (Bagenal and Tesch, 1978; Hile, 1936; Martin, 1949) as ideal for fresh water fishes. Values of 'b' above 3 are possible in some conditions such as stress free environments (Prasad and Anvar, 2007). The significant difference in regression coefficient of individual fishes agrees with the findings of Stewart (1998) who observed that other factors including environmental and management could also cause variations in b. Even though there was no significant difference in water quality parameters among the production ponds and the values were all within the recommended ranges, it is possible that food availability and feeding characteristics could cause differences in b in Kegati station.

Condition coefficient is one of the standard practices in fisheries used as an indicator of the variability attributable to growth coefficient (b). Here, the individual fish condition is determined based on the analysis of length-weight data reflecting that the heavier fish at a given length is in better condition, hence indicating favorable condition (Bolger and Connolly (1989). The mean condition coefficient (K) for the *O. niloticus* was 1.02 ± 0.04 and 1.12 ± 0.02 for males and females respectively. This finding is coherent with Ighwela et al., (2011) thus indicating that the fish

were above average in terms of condition. The condition factors were close to those reported by Olurin and Aderibigbe (2006) in juvenile *O. niloticus* where the condition factor was 1.14 in males and 1.08 in females. The condition factor higher than one suggests good fish health condition and indicates an isometric growth, which is the desirable in a fish farm (Ayode, 2011). There may be differences in the condition factor due to sex, environmental conditions such as pollution (Olurin and Aderibigbe, 2006). In this study the LWR was found to be in a linear form conforming to the general formula expressing the relationship between the length and weight of fishes. This perhaps suggests that best farm management practices applied in the station contributes to the steady increase in their weight and length. In this study, females of *O. niloticus* were heavier than males. This may be attributed to the higher fat accumulation and higher gonadal weight (Le Cren, 1951; Shafi and Quddus, 1974; Maguire and Mace, 1993 and Ahmad Dar et al., 2012).

Conclusion and recommendations

The authors conclude that Nile tilapia *O. niloticus* examined at Kegati aquaculture Research Station were in good condition and healthy and thus are suitable for larviculture purposes. Therefore, the LWR is an important indicator of their physiological status. A further study should be conducted to investigate the condition factor of Nile tilapia fingerlings obtained by the broodstock.

Acknowledgement

The authors are grateful to KMFRI for providing funds and enabling environment including equipment for the study

References

- Abdel-Fattah M El- Sayed (2002). Effects of stocking density and feeding levels on growth and feed efficiency of Nile tilapia (*Oreochromis niloticus* L.) fry. *Aquaculture Research* 33 621-626.
- Anyanwu, A.O., B.C. Okoro, B.I. Ebonwu, F. Ihimekpen and I.K. Ayaabu-Cookey et al., (2007). Length-weight relationship, condition factor and sex ratio of african mudcatfish (*Clarias gariepinus*) reared in indoor water recirculation system tanks. *Res. Biol. Sci.*, 2: 780-783.
- Ashagrie Gibtan, Abebe Getahun & Seyoum Mengistou (2008). Effect of stocking density on the growth performance and yield of Nile tilapia [*Oreochromis niloticus* (L., 1758)] in a cage culture system in Lake Kuriftu, Ethiopia. *Aquaculture Research* 1-11.
- Ayode, A.A. (2011). Length -Weight Relationship and Diet of African Carp *Labeo ogunensis* (Boulenger, 1910) in Asejire Lake Southwestern Nigeria. *J. Fisheries and Aquatic Sci.*, pp: 1816-4927.
- Bagenal TB, Tesch FW. (1978). *Methods for assessment of Fish Production I Freshwaters*. T.B. Bagenal 9ed.) I.B.P. Handbook No. Edn 33. Oxford Blackwell Publications. 1978, 365.
- Bolger, T. and P.L. Connolly, (1989). The suitable of suitable indices for the measurement analysis of fish condition. *J. Fish Biol.*, 34(2): 171-182.
- FAO (2012). *Fisheries global information system*. FAO Fisheries and Aquaculture Department, Food and Agriculture Organization of the United Nations Rome.
- Fitzsimmons K. (2005). Tilapia culture. In: Kelly A.M. and Silverstein J. (eds). *Aquaculture in the 21st Century*. American Fisheries Society, Symposium 46, Bethesda, Maryland. pp. 563-590.
- Gomiero, L. M., Braga, F. M. S (2005). The condition factor of fishes from two river basins in Sao Paulo state, Southeast of Brazil. *Acta Scientiarum*. 27:73-78.
- Hile, R., (1936). Age and growth of cisco *Leucichthyes arctedi* le Suercur in the lake of north eastern highland. *S. Bull. U.S.Bur. Fish*, 48: 211-314.
- Ighwela,KA, Ahmed, AB., and. Abol-Munafi, A.B. (2011). Condition Factor as an Indicator of Growth and Feeding Intensity of Nile Tilapia Fingerlings (*Oreochromis niloticus*) Feed on Different Levels of Maltose American-Eurasian *J. Agric. & Environ. Sci.*, 11 (4): 559-563
- Khallaf, E., Galal, M., Athuman, M. (2003). The biology of *Oreochromis niloticus* in a polluted canal. *Ecotoxicology*. 12:405-416.
- Lagler, K.F., (1970). Capture, sampling and examination of fishes In: *Methods for assessment of fish production in freshwaters* (ed, W.E. Ricker). IBP Handbook 3. Blackwell Scientific publications, Oxford and Edinburgh, pp: 7-45.

- Le cren, E. D., (1951). The length-weight relationship and seasonal cycle in gonad weight and condition in the perch *Perca fluviatilis*. *J. Anim. Ecol.*, 20(2): 201-219.
- Lizama, M. de los A. P. and Ambrósio, A. M. (2002). condition factor in nine species of fish of the characidae family in the upper paraná river floodplain, brazil. *Braz. J. Biol.*, 62(1): 113-124, 2002
- Maguire, J. J., & Mace, P. M. (1993). Biological Reference Points for Canadian Atlantic Gadoid Stocks. In: Smith, S.J., J.J. Hunt and D. Rivard (Eds.), *Risk Evaluation and Biological Reference Points for Fisheries Management*. *Can. Spec. Publ. Fish. Aquat. Sci.*, 120, 67-82.
- Martin, W.R. (1949). The mechanics of environmental control of body form in fishes. *Univ. Toronto. Stud. Biol.*, 58: 1-91.
- Moradinasab, GH. Daliri, M. Ghorbani, R. Paighambari, S.Y. Davoodi R. (2012). Length-weight and length-length relationships, Relative condition factor and Fulton's condition factor of Five Cyprinid species in Anzali wetland, southwest of the Caspian Sea. *Caspian J. Env. Sci.* Vol. 10 No.1 pp. 25-31
- Munguti, J. M., Mugiraneza, J. K. and Ogello, E. O. (2014). An Overview of Kenyan Aquaculture Sector; Current status, Challenges and Opportunities for Future Development. *Fisheries and Aquatic sciences*, 17(1): 1-11
- Nandlal, S., and Pickering, T. (2004). *Tilapia fish farming in Pacific Island countries. Volume 1. Tilapia hatchery operation*. Noumea, New Caledonia: Secretariat of the Pacific Community.
- Ogello E. O., Safina, M. M., Aura, C. M., Abwao, J. O. and Munguti J. (2014). A critical appraisal of feasibility of tilapia production in earthen ponds using biofloc technology, a review. *International Journal of aquatic sciences*, 5 (1): 21-39
- Olurin, K.B., Aderibigbe, O.A. (2006). Length-Weight Relationship and Condition Factor of Pond Reared Juvenile *Oreochromis niloticus*. *Journal of Zoology* 1:82-85.
- Pauly, D. (1983). Some simple methods for the assessment of tropical fish stocks. *FAO Fisheries Technical paper*, (234), FAO, Rome, Italy, 52 pp.
- Pauly, D. (1993). Linear regressions in fisheries research. *Journal of the Fisheries Research Board of Canada*, 30:409-434.
- Prasad G. and P.H. Anvar Ali (2007). Length-weight relationship of a cyprinid fish *puntius filamentosus* from Chalakudy River, Kerala. *Zoos' Print Journal* 22(3): 2637-2638.
- Robert J. Wootton (1990). *Ecology of teleost fishes*, Chapman, 2- 6 Boundary Row, London.
- Salama, M.E. (1996). Effects of sex ratio and feed quality on mass production of Nile tilapia, *Oreochromis niloticus* (L.), fry. *Aquaculture Res.*, 27(8): 581-585.
- Shabir Ahmad Dar1, A. M. Najar, M. H. Balkhi, Mohd Ashraf Rather and Rupam Sharma (2012). Length weight relationship and relative condition factor of *Schizopyge esocinus* (Heckel, 1838) from Jhelum River, Kashmir. *International Journal of Aquatic Science* Vol 3, No 1, 2012.
- Shafi, M. & Quddus, M. M. (1974). Length-weight relationship and condition factor in Hilsa ilisha (Hamilton) (*Clupeiformes: Clupeidae*). *Bangladesh J. Zool.* 2(2): 179-185.
- Stewart, K.M. (1988). Changes in condition and maturation of the *Oreochromis niloticus* L. population of Ferguson's Gulf, Lake Turkana, Kenya. *J. Fish Biol.*, 33: 181-188.
- Weatherley, A. H. (1972). *Growth and ecology of fish populations*. Academic Press., London, 293p.